ORAU

INDEPENDENT REVIEW OF THE DRAFT RADIOLOGICAL DATA EVALUATION FINDINGS REPORTS FOR PARCEL C SOIL; PARCELS D-2, UC-1, UC-2 AND UC-3 SOIL; AND PARCEL E SOIL FORMER HUNTERS POINT NAVAL SHIPYARD SAN FRANCISCO, CALIFORNIA

General Discussion

Per Agreement No. 101000961 between Oak Ridge Associated Universities (ORAU) and CH2M, ORAU has reviewed the following reports and associated appendices that were posted within the shared directory at https://delivery.ch2m.com/projects/684353, and related soil sample analytical data available in the Final Radiological Evaluation Database (FRED):

1. Preliminary Draft–*Radiological Data Evaluation Findings Report for Parcel C Soil,* Former Hunters Point Naval Shipyard, San Francisco, California, October 2017
2. Draft–*Radiological Data Evaluation Findings Report for Parcels D-2, UC-1, UC-2, and UC-3 Soil,* Former Hunters Point Naval Shipyard, San Francisco, California, October 2017
3. Draft–*Radiological Data Evaluation Findings Report for Parcel E Soil,* Former Hunters Point Naval Shipyard, San Francisco, California, December 2017

ORAU has previously reviewed and provided observations, considerations, and conclusions regarding the evaluation methods and resultant parcel report conclusions and recommendations. Furthermore, it is ORAU's understanding that the Hunters Point Naval Station (HPNS) data evaluation project has essentially qualified all Tetra Tech EC, Inc. (TtEC) generated data as suspect due to data falsification allegations, field and laboratory quality issues, and, among others, insufficient evidence that gamma scanning and static measurement anomalies were appropriately investigated. Because of the TtEC-generated data issues and corresponding stakeholder lack of confidence in the results, the project has initiated planning efforts intended to develop the hierarchical approach for conducting reinvestigation of yet to be defined decision unit populations. The specifics for the reinvestigations—referred to in various stakeholder documents and communications as confirmatory or "prove-out" radiological surveys and sampling—will be developed to provide the data necessary for making final release decisions for the various HPNS parcel trench/fill/excavation units, former building site units, and land area survey units. Multiple factors are under stakeholder consideration in the selection of decision unit boundaries and the

reinvestigation process rigor. Factors beyond the evaluation report data falsification findings and recommendations include radiological use history, positive contamination results in sediments, associations between various units, and backfill material (reuse/native fill vs. offsite fill).

ORAU's primary emphasis for this review was to independently assess those survey units designated as No Further Action (NFA), rather than further assess the evaluation methods, to determine if any additional survey units should be considered as candidates for investigation. A matrix was created of the individual survey units evaluated within the Parcel C; Parcels D-2, UC-1, UC-2 and UC-3; and Parcel E reports together with the evaluation Yes/No decision outputs. The matrix was filtered on two conditions: 1) a fundamental consideration of the revised conceptual site model, as to whether a survey unit was associated with, or downstream of, a building with historical radioactive material use, and 2) an NFA evaluation result. The gamma static and gamma scan observations were manually extracted from the filtered population's individual evaluation forms. The gamma results were reviewed for evidence of a degraded or otherwise unstable gamma measurement system—based on the lower tail of expected background count rates—or if the stated background investigation level (IL) was not representative of the response ranges, e.g., the IL was significantly above what would be considered a reasonable 99th percentile (or mean plus 3 sigma) of the stated gamma response range.

A related issue was noted with the Building 707 Triangle Area; Former 500 Series Buildings Area; and Former Buildings 506, 508, and 520. For these survey units, gamma scan data were reported in counts per second, and the levels reported indicated a different type of detector was used—a large-area detector was noted in some evaluation forms or other reports. Also, some static data were reported as net counts per minute. The review of these net results identified cases, similar to using an IL that was well above the reported detector response, where the background value subtracted was not representative, i.e., the background subtracted was too high and resulted in negatively skewed net gamma measurement ranges rather than centered around, both above and below, a zero net value.

Ultimately, if sodium iodide (NaI) detectors were under-responding due to crystal degradation or other performance issues, the IL applied was not representative of localized gamma radiation levels, or a non-conservative background was used in the conversion to net count rates, there is an increased probability of false negative decision errors. In other words, any anomalies that may have

been present within these surveys units were unlikely to have been recognized and appropriately investigated.

Table 1 provides the NFA survey unit population. Survey units considered as additional candidates for the further action investigation population work planning are highlighted yellow.

Table 1												
Parcel	**Unit**	**1.4**	**1.4.1**	**1.4.2**	**3.1**	**Scan Range**	**Static**	**Inv. Level**	**Rad Impact Prox.**	**Contamination Found?**	**Pass**	**Fail**
D2	TU031	Y	N	Y	No Further Action	4800-6100	4997-6144	6237 cpm	813	no	5	0
D2	TU032	Y	N	Y	No Further Action	3820-6040	consistent	6238 cpm	813	no	1	4
D2	TU034	Y	N	Y	No Further Action	4800-5600	3629-5627	5751 cpm	813	no	2	3
D2	TU035	Y	N	Y	No Further Action	4789-6100	4931-6185	6238 cpm	813	Ra-226	4	1
D2	TU038	Y	N	Y	No Further Action	3870-6090	4399-6210	6238 cpm	813	no	3	2
D2	TU134	N	N	Y	No Further Action	2200-6400	1444-4823	7000 cpm	813	Cs-137	3	2
UC3	TU170	Y	N	Y	No Further Action	No information provided	No information provided	No information provided	830	Ra-226	1	4
UC3	TU174	Y	N	Y	No Further Action	Scan survey performed on 08/17/10 at 10:00 before FSS sample collection. Gamma scan dataset is inconsistent with static data (range of scan much larger than static data)	Inconsistent with scan data (range much smaller than scan data range reported)	n/a	815	no	4	1
UC3	TU178	N	N	Y	No Further Action	3920-7060	5004-5632	7204 cpm	820	Cs-137	2	3
UC3	TU183	Y	N	Y	No Further Action	3120-6870	consistent with scan data but value range not provided	7204 cpm	815	no	1	4
UC3	TU187	Y	N	Y	No Further Action	2830-6390	consistent with scan data but value range not provided	7204 cpm	815	no	2	3

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Parcel	**Unit**	**1.4**	**1.4.1**	**1.4.2**	**3.1**	**Scan Range**	**Static**	**Inv. Level**	**Rad Impact Prox.**	**Contamination Found?**	**Pass**	**Fail**
UC3	ES271	Y	N	Y	No Further Action	max 1523 cps; Ave 1059 cps (Large Area Detector)	n/a	1215 cps	830, 820, 815	Ra-226	3	1
UC3	ES281	Y	N	Y	No Further Action	Max 1815 cps; Ave 1165 cps (Large Area Detector)	n/a	1215 cps	830	Cs-137 & Ra-226	3	2
UC3	ES284	Y	N	Y	No Further Action	Max 1815 cps; Ave 1165 cps (Large Area Detector)	n/a	1215 cps	830	Cs-137 & Ra-226	4	1
UC3	ES285	Y	N	Y	No Further Action	Max 1644 cps; Ave 1225 cps (Large Area Detector)	n/a	1215 cps	830	Cs-137 & Ra-226	3	2
UC3	ES287	Y	N	Y	No Further Action	Max 1517 cps; Ave 1200 cps (Large Area Detector)	n/a	1215 cps	820	Ra-226	5	0
C	TU193	Y	N	Y	No Further Action	2890-7730	4315 - 4546		241	no	5	0
C	TU211	Y	N	Y	No Further Action	2940-7580	5332-6025		241	no	4	0
C	TU212	Y	N	Y	No Further Action	3170-7380	4013-7011		241	no	5	0
C	TU226	Y	N	Y	No Further Action	3220-7840	5017-5601		272	no	2	3
C	TU227	Y	N	Y	No Further Action	5870-7890	5897-6320		241	no	2	3
C	TU232	N	N	Y	No Further Action	3860-7550	5471-5831		203 & 272	Ra-226	2	3
C	TU244	Y	N	Y	No Further Action	4300-7590	3030-6235	7707 cpm	211	no	3	2
C	TU247	N	N	Y	No Further Action	2990-7480	n/a	8029 cpm	203	no	3	2
C	TU317	N	N	Y	No Further Action	3600-7440	inconsistent - minimum static results are less than the	7707 cpm	271	Ra-226	2	3

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Parcel	**Unit**	**1.4**	**1.4.1**	**1.4.2**	**3.1**	**Scan Range**	**Static**	**Inv. Level**	**Rad Impact Prox.**	**Contamination Found?**	**Pass**	**Fail**
							minimum scan results					
C	TU325	Y	N	Y	No Further Action	3210-11200	3150-9829	7707 cpm	211	contained firebrick material	1	4
C	TU327	Y	N	Y	No Further Action	2410-19000	consistent	7707 cpm		NORM	2	3
C	ES307	Y	N	Y	No Further Action	max 1465 cps; Ave 1225 cps(Large Area Detector)	n/a	1215 cps	820 & 830	Ra-226	1	4
C	ES327	Y	N	Y	No Further Action	max 1706 cps; Ave 1166 cps(Large Area Detector)	n/a	1215 cps	815	Cs-137 & Ra-226	2	3
C	ES334	Y	N	Y	No Further Action	max 2004 cps (Large Area Detector)	n/a	1215 cps (assumed)	815		2	3
C	ES390	Y	N	Y	No Further Action	max 1297 cps; Ave 953 cps(Large Area Detector)	n/a	842 cps	214	Ra-226	0	5
C	ES392	Y	N	Y	No Further Action	max 1264 cps; Ave 867 cps(Large Area Detector)	n/a	842 cps	214	Ra-226	2	3
C	ES440	Y	N	Y	No Further Action	max 1187 cps (Large Area Detector)	n/a	842 cps (assumed)	241	Ra-226	4	1
C	North Pier S0001	Y	N	Y	No Further Action	max 857 cps; Ave 644 cps(Large Area Detector)	n/a	970 cps		Ra-226	1	4

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Parcel	**Unit**	**1.4**	**1.4.1**	**1.4.2**	**3.1**	**Scan Range**	**Static**	**Inv. Level**	**Rad Impact Prox.**	**Contamination Found?**	**Pass**	**Fail**
C	North Pier S0002	Y	N	Y	No Further Action	max 849 cps; Ave 613 cps(Large Area Detector)	n/a	970 cps	Berthing for Operation Crossroads ships, radioactive waste disposal barge, and NRDL experimental barges		3	1
C	North Pier S0009	Y	N	Y	No Further Action	max 872 cps; Ave 599 cps(Large Area Detector)	n/a	970 cps	Berthing for Operation Crossroads ships, radioactive waste disposal barge, and NRDL experimental barges		3	2
E	TU165	Y	N	Y	No Further Action	4170-4820	4278 ± 73	6712 cpm	810		2	2
E	TU222	Y	Y	Y	No Further Action	3710-7500	3660-4012	8028 cpm	500 series	Cs-137	1	4
E	TU223	Y	Y	Y	No Further Action	3160-7890	4936-5407	8028 cpm	521		1	4
E	TU240	Y	Y	Y	No Further Action	3030-7370	"Middle of scan range"	8028 cpm	521		3	2
E	TU246	Y	Y	Y	No Further Action	3100-6500	4211 ± 68	8028 cpm	520	Cs-137, Ra-226, and Sr-90	5	0
E	TU248	Y	Y	Y	No Further Action	3200-7600	No information provided	8028 cpm	506		3	2
E	TU307	Y	Y	Y	No Further Action	3700-6310	5030-5463	7638 cpm	505 & 520	Ra-226	4	1
E	TU308	Y	Y	Y	No Further Action	4120-6400	5112-5576	7638 cpm	500, 505, 521		2	3
E	ES245	Y	Y	Y	No Further Action	Max 1569 cps	No information provided	1215 cps	707 triangle		1	4

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Parcel	**Unit**	**1.4**	**1.4.1**	**1.4.2**	**3.1**	**Scan Range**	**Static**	**Inv. Level**	**Rad Impact Prox.**	**Contamination Found?**	**Pass**	**Fail**
E	ES248	Y	Y	Y	No Further Action	No information provided	No information provided	No information provided			1	4
E	Bldg 414 (S0001)	Y	N	Y	No Further Action	3237-6829	4599-6383	7036 cpm	414		2	2
E	Bldg 414 (S0002)	Y	N	Y	No Further Action	3400-6980	4364-6443	7666 cpm	414		3	1
E	Bldg 414 (S0003)	Y	N	Y	No Further Action	3332-6957	4545-6308	7036 cpm	414		3	2
E	Bldg 414 (S0004)	Y	N	Y	No Further Action	3187-7519	4738-6593	7666 cpm	414		3	2
E	Bldg 414 (S0005)	Y	N	Y	No Further Action	3210-7419	3925-6375	7666 cpm	414		4	1
E	Bldg 414 (S0006)	Y	N	Y	No Further Action	3120-7350	4997-6390	7666 cpm	414		4	1
E	Bldg 414 (S0008)	Y	N	Y	No Further Action	3582-7513	5122-6584	7684 cpm	414		3	2
E	Bldg 414 (S0010)	Y	N	Y	No Further Action	4132-7609	4791-5753	7666 cpm	414		3	2
E	Bldg 500 (S0004)	Y	Y	Y	No Further Action	3117-7041	4119-7104	7049 cpm	500	Cs-137	2	1
E	Bldg 701 (S0004)	Y	N	Y	No Further Action	see comment	4401-5775	6712 cpm	former bldg. 701	Cs-137 & Ra-226	3	2
E	Building 707 Triangle Area (S0009)	Y	Y	Y	No Further Action	app 90% of scan meas > IL	11 meas > IL	1215 cps	707	Sr-90	0	5
E	Building 707 Triangle Area (S0015)	Y	Y	Y	No Further Action	app 50% of scan meas > IL	3 meas > IL	1215 cps	707	Cs-137 & Sr-90	0	5
E	Building 707 Triangle Area (S0016)	Y	Y	Y	No Further Action	0% of scan meas > IL	3655-9095	unclear	707	Cs-137 & Sr-90	2	3
E	Building 707 Triangle Area (S0017)	Y	Y	Y	No Further Action	0% of scan meas > IL	4046-9316	1215 cps	707	Cs-137 & Sr-90	2	3
E	Building 707 Triangle Area (S0020)	Y	Y	Y	No Further Action	more than 99% of scan meas > IL	5 meas > IL	1215 cps	707	Cs-137 & Sr-90	0	5
E	Building 707 Triangle Area (S0023)	Y	Y	Y	No Further Action	0% of scan meas > IL	9 meas > IL	907 cps	707	identified but not specified	0	5
E	Former 500 Series Buildings Area (S0003)	Y	Y	Y	No Further Action	2 meas > IL	4443-9884	907 cps	500 series	Ra-226	0	5
E	Former 500 Series Buildings Area (S0009)	Y	Y	Y	No Further Action	0 meas > IL	2921-7647	907 cps	500 series	Cs-137	1	4

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E	Former 500 Series Buildings Area (S0010)	Y	Y	Y	No Further Action	0 meas > IL	5147-7687	1055 cps	500 series	n/a	3	2
E	Former 500 Series Buildings Area (S0014)	Y	Y	Y	No Further Action	0 meas > IL	-3562-992 (net cpm)	907 cps	500 series	Cs-137	1	4
E	Former 500 Series Buildings Area (S0015)	Y	Y	Y	No Further Action	2% of scan meas > IL	2066-2165 (net cpmt)	907 cps	500 series	Cs-137	3	2
E	Former 500 Series Buildings Area (S0017)	Y	Y	Y	No Further Action	0 meas > IL	-1540-1766 (net cpm)	907 cps	500 series	Cs-137	2	3
E	Former 500 Series Buildings Area (S0019)	Y	Y	Y	No Further Action	0 meas > IL	-1793-1349 (net cpm)	907 cps	500 series	Cs-137	4	1
E	Former 500 Series Buildings Area (S0020)	Y	Y	Y	No Further Action	0 meas > IL	-1784-1427 (net cpm)	907 cps	500 series	Cs-137	2	3
E	Former 500 Series Buildings Area (S0021)	Y	Y	Y	No Further Action	0 meas > IL	-2654-958 (net cpm)	907 cps	500 series	Cs-137	1	4
E	Former 500 Series Buildings Area (S0022)	Y	Y	Y	No Further Action	0 meas > IL	-1824-1231 (net cpm)	907 cps	500 series	Cs-137	2	3
E	Former 500 Series Buildings Area (S0026)	Y	Y	Y	No Further Action	0 meas > IL	-1957-1109	907 cps	500 series	n/a	2	3
E	Former Building 506 (S0002)	Y	Y	Y	No Further Action	0 meas > IL	5040-6425	7004 cpm for static; 907 cps for scan	500 series	n/a	3	2
E	Former Building 506 (S0003)	Y	Y	Y	No Further Action	3% of scan meas > IL	3778-7734	7004 cpm for static; 907 cps for scan	500 series	n/a	3	2
E	Former Building 506 (Waste Tank)	Y	Y	Y	No Further Action	n/a	n/a	n/a	500 series	Cs-137 & Sr-90	2	2
E	Former Building 508 (S0001)	Y	Y	Y	No Further Action	max 707 cps; ave 521 cps (Large Area Detector)	3691-5662	907 cps	500 series	n/a	2	3
E	Former Building 520 (S0001)	Y	Y	Y	No Further Action	max 723 cps; ave 534 cps (Large Area Detector)	3665-6404	7004 cpm for static; 907 cps for scan	500 series	n/a	5	0
E	Former Building 520 (S0002)	Y	Y	Y	No Further Action	max 694 cps; ave 524 cps (Large Area Detector)	4329-6206	7004 cpm for static; 907 cps for scan	500 series	n/a	5	0

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E	Former Building 520 (S0003)	Y	Y	Y	No Further Action	max 834 cps; ave 557 cps (Large Area Detector)	6730-7935	7001 cpm for static; 839 cps for scan	500 series	n/a	2	3
E	IR Site 4 Former Scrap Yard Site and Former Building 807 Site (S0001)	Y	N	Y	No Further Action	1034-2027 cps	4837-8065	9213 cpm for static; 2377 cps for scan	807	n/a	0	5
E	IR Site 4 Former Scrap Yard Site and Former Building 807 Site (S0002)	Y	N	Y	No Further Action	975-1984 cps	4072-7831	9213 cpm for static; 2377 cps for scan	807	n/a	0	5
E	IR Site 4 Former Scrap Yard Site and Former Building 807 Site (S0003)	Y	N	Y	No Further Action	1121-2062 cps	5058-7735	7735 cpm for static; 2377 cps for scan	807	n/a	0	5
E	IR Site 4 Former Scrap Yard Site and Former Building 807 Site (S0007)	Y	N	Y	No Further Action	max 1995 cps; ave 1693 cps (Large Area Detector)	-2093-75 (net cpm) [7201-9369]	9479 cpm for static; 2377 cps for scan	807	Ra-226	1	4

Assumptions: TtEC used 2-in × 2-in NaI detectors. Typical ORAU NaI gamma background count rates obtained from geographically similar sites were assessed to establish a mean and standard deviation, and the relative standard deviation (RSD) calculated. The average RSD was 0.12. This RSD was assumed as a nominal value and applied to TtEC scan range data mid-points, assuming the mid-point is a reasonable basis upon which to estimate a mean. The mid-points were averaged to obtain an estimated mean response of 5,500 cpm. This estimated mean was multiplied by the 0.12 RSD, resulting in an estimated one sigma of 630 cpm. Based on this, an expected count rate range was calculated for mean ± 3 sigma. TtEC has been setting the IL at the mean + 3 sigma. The estimated nominal range would therefore be 3,600 to 7,400 cpm. Values less than 3,600 represent a <1% probability of occurring due to random chance based on assumed normal distribution. Gamma ranges where the minimum value was <3,600 cpm were identified as an under-response or where the localized detector response distribution was below the nominal background count rate population distribution upon which the IL had been based.